Metamorphosis

Into a New Era

Vol 1, Nbr 9 | For the CoCo/OS9/OSK Communities | April Fool's

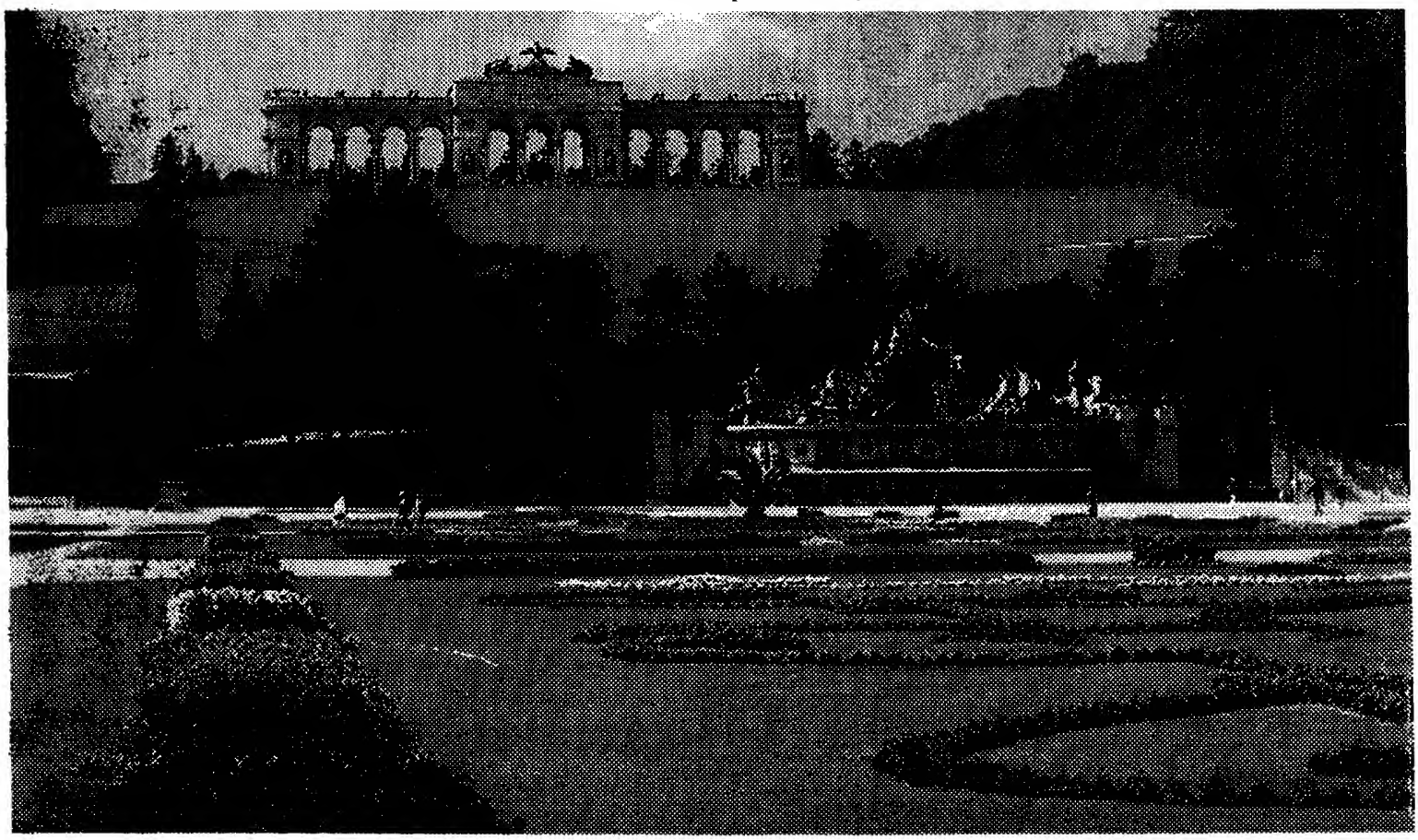
Review of the new MS-DOS Emulator

Hardware: The new PentiumPlus CPU

OS-9 and Uncle Sam

Lots of Stuff!

(Below – The *Metamorphosis* Home)



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AN OS-9 FIRST - the MICROPROCESSOR is mounted on a daughter board which plugs onto the motherboard. This will permit inexpensive upgrades in the future when even greater performance is required.

G-WINDOWS benchmark performance index 0.15 seconds faster with a standard VGA board than a 68030 running at 30 MHz with ACRTC video board (85.90 seconds vs 86.05 seconds).

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132 x 44,	132 x 60

Foreground, background and border colors are user selectable from up to 16 colors.

Eleven graphics modes are supported -

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640 x 350 x 16,	640 x 350 x 256,
640 x 480 x 16,	640 x 400 x 256,
800 x 600 x 16,	640 x 480 x 256,
1024 x 768 x 16,	800 x 600 x 256,
	1024 x 768 x 256

Text and graphics modes may be selected by a utility provided, MODESET, by software using SetStt calls, or by termcap entries. In the text mode, the screen responds to standard VT100 control sequences. The full character set from Hex 20 through Hex FF is suppported in text modes up to and including 100 characters wide. The upper 128 characters follow the 'IBM Character Set 2' popular with many terminals and printers. These may be displayed on the screen by using the 'Alt' key and one or two other keys (software permitting).

G-WINDOWS option provides 3 screen resolutions; 640 x 480 x 256, 800 x 600 x 256 or 1024 x 768 x 256. You can have 2 full size 80 x 25 windows with room to spare. Or, a window as large as 122 x 44 using the large fonts or a window over 180 x 70 using the small fonts.

delmar co

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April Fools 1994, Vol 1, Nbr 9

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Metamorphosis
Published monthly by
The Dirt Cheap Computer Stuff Company
1368 Old Highway 50 East
Union, Missouri 63084

Copyright© 1994
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Subscriptions
Metamorphosis is published 12 times a year. Subscription rates are $24 per year for the continental United States. Canadian rates are $32 (US) per year. Overseas rates vary. Please write for details.

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This publication is composed, formatted, and master pages created entirely on machines running the OS-9 operating system.

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On the Front Cover

A picture of the *Metamorphosis* building, looking from the south across the gardens. We live on the second floor in the West Wing. Guest housing is in the East Wing. Our offices are situated beneath the eagle crest on the roof.

This issue is a parody of the computer world in general and the OS-9 community in particular. All of the information contained in this issue is presented in the spirit of fun and is not intended to cause harm or otherwise offend anyone. All names used are used in this spirit and any comments attributed to these individuals is purely fictional. Some advertisements are completely fictional and do not represent any currently available items at any price. These should be obvious. The remainder of the advertisements are completely legit.

From The Editor's Desk

Thank goodness it is April. Those of us living in the North can finally begin to thaw out. We can also quit feeling so jealous of those lucky enough to live in warmer climes. Also, those in the South can finally quit laughing at us as they watch tapes on the evening news of us shoveling snow and wrecking our cars.

Yes, we can finally venture outside without hats, coats, scarves, gloves, and boots. We can finally go out with only one layer of clothes on which means we can finally go outside and be able to bend our arms and legs. People in the South take this for granted.

Now all we need to venture out into the great outdoors is a raft and about a week's worth of food and clothing. Alas, the spring rains have caused a return of last summer's floods. Many people in the Midwest, however, have learned the hard way how to "go with the flow."

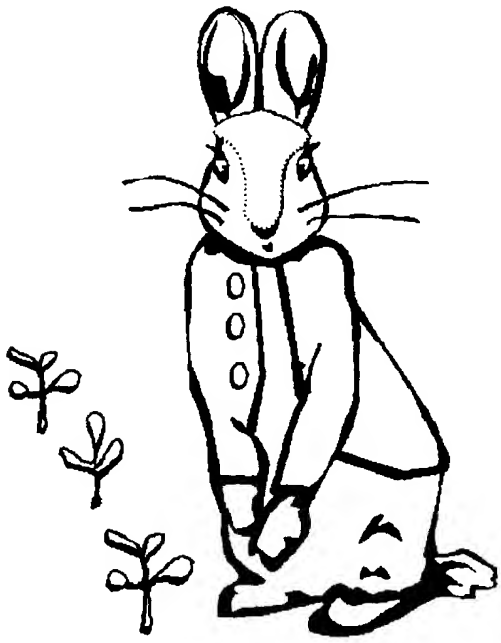
We were truly blessed this year with a beautiful Easter Sunday. It was a most welcome day, with sunshine, warm temperatures, birds singing, and flowers blooming. Ah, Spring is a great time of year . . . when it's not raining. "April showers bring May flowers" the age old saying goes. We have discovered that April snow and hail storms bring brown, mushy daffodils and turn our beautiful green plants into brown slime. All things considered, Mark and I still love the Spring.

Anyway, Easter Sunday was a gorgeous day. Our family was outside enjoying just being outside. The dogs were doing their morning business of watering and fertilizing our lawn. We were walking around the yard checking out all the buds on the trees and flowers when we heard this awful yelp from the dogs in the back yard. Never have I heard our dogs give such a yelp so I knew something was up.

We all ran to the backyard to see what could elicit so much noise. And what did we discover? It seems the Easter Bunny had ventured into our yard. With one giant leap, Buck was in pursuit of that basket-carrying bunny. The noise attracted the other dogs, and soon Samantha, our miniature black lab, and the neighbors' dogs Bumper-Jack (yes, Bumper-Jack) and Beavis (yes, Beavis) soon joined in the chase. There was yelping and howling from the dogs and brightly colored eggs and candy flying everywhere. That bunny darted here and there and was able to outwit Beavis and Bumper-Jack and out maneuver Samantha and Buck. The dogs really gave that old Easter Bunny a workout. Luckily for all the little children of the world, the Easter Bunny is crafty, very fast, and agile. (This must be how he has survived all these years.)

After the excitement died down, we went around picking up the eggs and candy and went about our business of enjoying the beautiful day. Next Easter we will have to leave the dogs indoors until we are sure the Easter Bunny has been here and gone.

We at Metamorphosis hope all of our readers are having a wonderful Spring.



Mail Call!

Kudos From the Top

Dear Mark and Barbara:

What a pleasure it is to receive your magazine. Bill is always the first to grab it and reads it over and over again. He sometimes asks me lots of questions, which I of course can't answer. Lucky for us we can get our answers via the Internet. Our thanks go out to all those nameless people that have helped us to understand the OS/2 operating system. We are glad to be a part of the OS/2 community. What a nice bunch of people.

I do have a question that perhaps your readers can answer. Each time I go to a computer store to buy one of those "MM/1" computers to run OS/2 on, the sales people have no idea what I'm talking about. Can you help me to find one of these machines? Bill wants to use it to help figure out how to finance the new health plan.

Thanks to you both,

Hillary Rodham Clinton

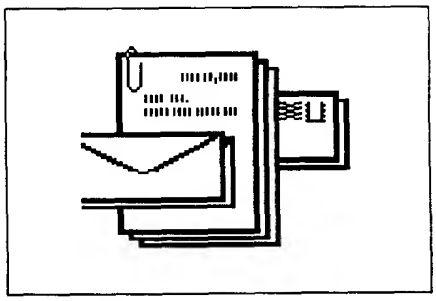
Hillary, I think you need to talk to the people at **Whitewater Computer Consultants.** *They'll be able to help you, I'm sure.—Barbara*

Dear Barbara,

Please put me down for a subscription to your excellent magazine. I was able to read a copy once while attempting a leverage buyout of Microware Corporation. I was just sitting the on the table, so while the lawyers fought, I looked it over. Since I was not getting my way, I figured I should at least find out why so many people are so loyal to this upstart company. After reading your magazine and asking a few cleverly disguised questions on DELPHI, I found out that the OS-9 operating system is everthing I was hoping to make Windows NT into. I need to learn more. I'm looking forward to receiving my next issue.

Bill Gates

Thanks for the nice words Bill! If you want to learn more, this is the place. You'll be happy to read about the MS-DOS emulation program that is reviewed in this issue. Perhaps that will generate some more sales for you. Thanks again.—Barbara



Microware Releases OS-9!

Dear Mark and Barbara,

We have been watching the progress of your magazine for some time now. For several years we have been looking for an organization that we could turn over the rights and code for the OS-9 operating system too. We think we have found that company. Within the next few weeks we will be sending you printout listings of the entire OS-9 Level I system. Sorry, be we lost the electronic copies a long time ago. We also give you permission to print these listings in your magazine for the benefit of all OS-9 users everywhere. If this goes well, we be in a position sometime around the year 2032 to release the source to Level II. Keep up the good work.

Ken Kaplan

FLAME ON!

Dear barbara,

i normally dont write to magazines but your latest editor was SO OUT of line that I felt COMPELLED to take pen in hand!!!! what do you mean by puting in this magazine that i spend GOOD MONEY FOR anything that is NOT releated to coco os-9 or what??!!??!?! we really don't really care to read about how wondeful spring is or how you can drive a SCHOOL BUSS!! we only want to read more about computers and how they can make our lifes easyer. PLEASE KEEP TO THE THEMES!!!!!!!!

a loyal reader

I'm sorry that you find my monthly comments so offensive. I do try to write something that might be thought provoking to our readers. Judging from your letter, you are in desperate need of a spelling and a grammar checker for your machine. It seems your computer doesn't know how to spell and most of the punctuation keys and the shift keys don't work. Also, you might find yourself more at home writing flames on DELPHI or some other service. Your writing style would fit right in. Check it out sometime.—Barbara

News Clips

Machine Rumors

Some more rumors have been surfacing about the new OSK machine soon to be available. It looks like this box will sport a Motorola 68040 processor running at 350 Mhz. These special order chips were developed by Motorola exclusively for this application. In addition, the machine will come with 64 Megabytes of memory as a *standard* item, and will include a built in TV with 200 channel cable turner, and voice recognition system that makes a keyboard completely unnecessary! In fact, there is no connector to plug it in! All this can be had by turning in your old CoCo system along with $50. Oh, it will also run all your CoCo Level II and Disk BASIC software in native emulation mode.

Latest KWindows Now Shipping

KWindows version 146 is now available from RedBird Enterprises. This version promises to fix the gs_palette() bug and introduce a few more. Documentation is still in the works and will be available as soon as a final version is finished. Kev Darlington, KWindows developer, said when asked about the final version, "Just one more feature to add and it'll be ready!"

Next Fest Dates Announced

The Atlanta CoCo Club announced this years CoCoFest will be on the 15th and 16th of October. The location, however, has been changed to the back room of the Jack-In-The-Box on 23rd street and Central avenue. "Attendance at recent shows has been less than expected" said club president Arnold "CoCoNut" Jones. He also said the new location will have ample parking for Fest attendees as well as great discounts on food.

Mark Griffith

AniMajik Productions

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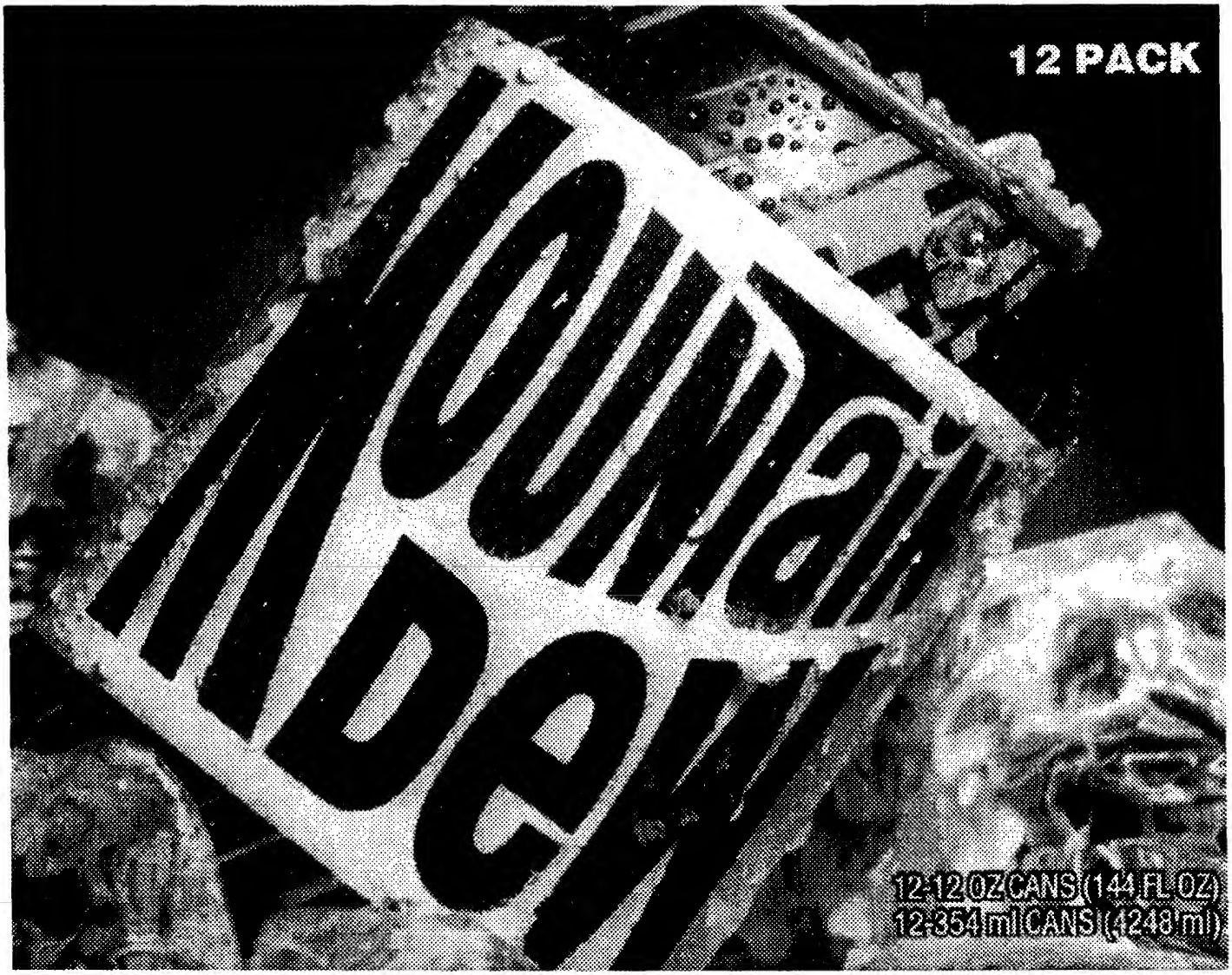
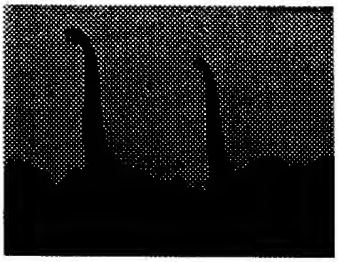


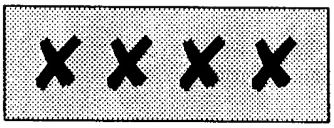
Loads of Caffein!
Program All Night Long
Generate More Code
Sell More — Make More!!

Review: MSDOS Emulation for OS-9

by Neil Phantom

Neil is a non-OS-9 computer enthusiast that lives next door to the Metamorphosis offices. We asked him to review the new OS-9/MS-DOS emulator and give his feelings. Neil has no idea what OS-9 is, nor is he aware that there is any other operating system besides MS-DOS. We figured he was the best candidate for the job.





When I was asked to write a review of this thing called an MS-DOS emulator, I was shocked. Not that they asked me, but that someone would even consider using something else than good 'ol DOS for all their computing needs. After all, isn't DOS the King of the computer world? Why else would so many great applications be written for it if it was not the best there was?

My first encounter with the emulator was at the *Metamorphosis* offices where Mark Griffith showed me a computer he called an "MM/1". I had never heard of this model and asked who sold it. He said it was originally sold by some company named "IMS," but now could be gotten through someplace called "BlackHawk Enterprises." I didn't really understand, but I took his word for it. I was sat down in front of a perfectly good 'ol DOS machine, an older Everex Step, running a 10 Mhz 8086. I told him that no emulator would run very well on this low level machine, but he just smiled and said it was only going to run as a terminal emulator. I had seen these things before and told him this was nothing new. Terminal emulators are something that every Computer Science students writes, even if there are already 5000 others just like it out there. Anyway, he said they only use this DOS box as a terminal to the OS-9 machine (whatever that is) and to keep his wife's recipe database. That seemed like a waste of computer power to me. Mark proceeded to run some program he said was a ANSI terminal emulator on the Everex, then walked over to the MM/1 and typed something. All of a sudden, a strange prompt appeared on my screen. It looked like this:

```
OSK:
```

I was now instructed to type the command **MSDOS,** and start the emulator. Well, I wasn't too sure what he was doing, but I let him know again that no emulator was going to run very fast on this old and slow machine. He needed to get a 486DX2 or a Pentium to do any real work. However, I humored him and went along with his little game. I figured that once he saw I was right, he'd give it up and go out and buy a **real** computer.

I typed in the command, and the normal MS-DOS boot screen appeared. I thought the Everex had rebooted itself, but Mark assured me it was working just fine. I gingerly tried a few commands like **dir** and **chkdsk.** They worked perfectly, except that **chkdsk** said this machine had 8 Meg of memory and a 120 Meg hard drive installed. I knew this was wrong since all the 8088 and 8086 machines only supported 640k of memory. Mark said it was right since it was showing the memory and drive of the host machine, the MM/1, and not the Everex Step. Huh? I tried a few more things like running the Norton Utilities and wham!.....it came up right away. I ran the Norton benchmark utility and it said this machine was now running at about the same Norton index as a 486/66 Mhz machine and the disk transfer rate was almost 2 Megabytes a second! Something was wrong here! I pointed this out and mentioned that a 10 Mhz 8086 couldn't do this. Again, Mark said it wasn't running on the Everex, but an MS-DOS emulator was running on the MM/1 and the Everex was just the display device. Huh??

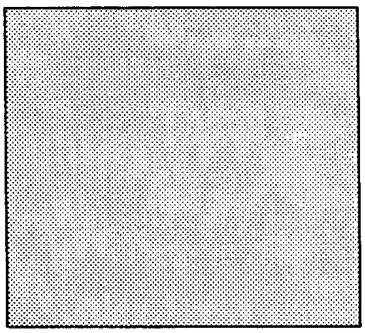
Oh! I get it! The MM/1 was running a Pentium or something like that and was sending its output to the screen memory on the Everex. Neat idea, I thought, but not too practical. Mark corrected me again and said that the MM/1 had a Motorola 68340 CPU installed and was running an operating system called OS-9/68000. Running under that operating was a program called an MSDOS emulator that allowed this OS-9 machine to run DOS programs. What??!! I was wondering

if this guy knew what he was saying. To make it worse, he then said he could run other OS-9 programs on his machine while I was running the MSDOS emulator **at the same time!** This guy is nuts!! Even Windows NT can't do this unless it is running on a 200 Mhz DEC Alpha chip, and even then it crashes a lot. Now he's trying to tell me that he can run more than one program (he called it "multi-tasking") on a Motorola 68040. Opps, he said 68340? What is that?

Just to prove him wrong, I backed up to the `C:>` prompt and did a `dir`. Sure enough, he had a copy of Windows 3.1 installed. He cautioned me that the Windows emulation was not fully debugged, but I ran it anyway. Wow! It sure came up fast! I tried a couple utilities and checked out Solitaire. Everything ran fine and noticeable faster than on my 486DX2 at home. I asked him if he had a Windows accelerator card installed, and he said he didn't, but the display was going to the Everex through a 38.4 Kbaud serial connection. Double what!!??

While I was checking all this out, I noticed he was doing something so I asked what. Mark said he was just playing a new game that was being ported to the OS-9 environment. Cool. It was some sort of 3-D tank battle field game with very fast graphics and sound. He also asked if I had seen the new music CD player he was testing. He then put a music CD into his CDROM reader and typed in a command. A little window popped up that looked like the front panel of a CD player. He pushed a couple buttons and the strains of Mozart's 40th symphony played throughout the room. I said I had the same capability at home, but then he did something that **totally** freaked me out! While Mozart was playing, he went back to the tank battle game and continued to play, with no degradation of the speed, and all the stereo game sounds still worked! And, he said the MSDOS emulator on the Everex box was still running and he wanted to know if I needed to test it some more!!

It was now obvious to me that he was playing some kind of trick on me and I just left, slamming the door good and hard. Everyone knows that you can't do that kind of multitasking on anything less than a Windows NT box with at least a couple of high speed Pentiums installed and 16 Meg of memory or more. So the results of my review is this—it's vaporware! Don't even bother to look into this. I must also apologize for my ex-friend and his attempts to make good 'ol DOS look bad. We must all learn to forgive, I suppose.



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Uncle Sam and OS-9

by Bob Brainard

Bob Brainard, is a U.S. government engineer working with the Department of Internal Affairs. He has been heavily involved with development of many of the government's computer systems and is currently working on a top secret project to communicate with alien life forms living under the surface of the planet Jupiter. He can be reached at **brain@dia.gov.gov.**

For many years now, our government has been using the OS-9 operating system to run quite a number of their computer systems. Lots of rumors have been floating around about some of these systems, but most have been only partly true. I've heard most of them, and I think it is time to set the record straight.

One of the most important, and less well known, of the government computer systems is the GCMS, or Government Civilian Monitoring System. This is a network of geostationary satellites that are positioned over the United States. Its purpose is to gather intelligence data on the civilian population by monitoring all electronic communication media. Since almost all our daily communication is via telephone, FAX, computers, etc., an enormous amount of information can be gleaned by constant monitoring. However, the huge amounts of data that is beamed down from the satellite network each day require computers of equally enormous processing power, not to mention true real-time capabilities.

When it was completed in the late 1980's, the GCMS consisted of about 300 satellites strategically positioned over locations in the U.S. that enabled them to gather data for an entire region. Each satellite sent its data stream to a receiver unit placed in the back yard of a government employee (they wouldn't be noticed that way). The computing system needed to be small, relatively self-sustaining, and able to run continuously for years.

While the satellite system was being put into place (you remember all those shuttle flights that had "secret" cargo back in the 80's), the system designers were searching for a suitable compact computer system that could be placed in each site to handle the incoming data. Since much of the budget had been spent on launching the satellites (and trips to the Bahamas for "planning" meetings), the money allocated for the individual computer systems was only around $600.00 each. After much searching, the engineering team stumbled over the little Radio Shack Color Computer 2 (and later the model 3) along with the OS-9 Levels I and II operating systems. Initial testing showed that all the requirements could be met with little or no modifications. A special external interface similar to the Multi-Pak was developed to handle the high speed serial interface from the dish antenna and a special modem for transmitting the collected data to a centralized machine. The CoCo circuit boards were stripped from the cases and mounted in specially developed EMF hardened containers. The keyboards were then sold back to Tandy which eventually offered them at drastically reduced prices to the consumers.

One aspect the government had not foreseen was the gradual increase in interest in the Color Computer and the OS-9 OS. Slowly, a fear developed in higher circles of what might happen if this machine and OS combination were to become the predominant system in the business and home hacker fields. Many of the GCMS top level management feared the possibility of hackers breaking into the closed system and then of business getting hold of this information. The results would have been catastrophic. So, in their typical knee-jerk reaction, the government made sure this would not happen by convincing Tandy Corp. to kill the Color Computer product line, and also placed pressure on OS-9 software developers to move to another system. The results of the government efforts was to reduce the CoCo and OS-9 following to a relatively few fanatics who could be easily monitored.

Next month, we'll continue our discussion on the GMCS usage of OS-9 and also look into the involvement of OS-9 during Desert Storm.

D_____Windows!

by Dorian Gray

Mr. Gray, (184), has been a user of CoCos and OS-9 since time began. He is currently involved with a blonde 18 year old that works for his neighbor. He keeps on his toes by programming his computer to give him electro-shock treatments 5 hours a day, by jogging, and mostly by endless hours sitting in front of his machine.

As we move along in our journey through the maze of D_____Windows programming, I am hesitant to reveal to you one of the least known features of this windowing system. In fact, I am the only person ever to discover it. This feature, which is very powerful, can backfire on the programmer if he or she is not extremely careful. What I am talking about is the gs_ssoul() function. Literally, it means Get Status of the Stored Soul.

This function first received attention after I, your D_____Windows developer, read a book way back in the early '80's titled *The Soul of a New Machine.* I thought about this for a number of years before the idea hit me to put computers to a use that no one had envisioned before. That is, to use the vast storage capacities of these machines to digitally capture the essence of your being, or your soul, and keep it on record, to be viewed or called back at a later time.

I discovered that not only can your reflection be seen in the computer monitor's glass front, but the screen memory can be read between refresh cycles, and a picture of the soul of the person sitting in front of the screen can be captured and stored. The image is only there for a very slight fraction of a second (2 ms nominal), so the software to capture it must be extremely quick. I had to resort to writing in assembler to achieve the speed required. You can call this function from within a C program, and it will perform the image capture and store it in a filename passed to it when called. For example:

```
gs_ssoul(``my.file'')
```

will update "my.file" with the current image. Some people will feel a slight "tingling" sensation when this happens, but it only lasts for a couple milliseconds. Most people won't even notice.

There are, however, a few caveats to this function. I have found that it is slightly addictive. For reasons I have yet to explain, there is a feeling that I have been invigorated each time I update the image. Amazingly enough, in the years that I have been steadily storing my image data, I appear to not have aged at all. Each time I go out bar crawling and womanizing, I return home, sit down on the machine, and capture a few image updates. This usually leaves me feeling "cleansed" and ready for a good nights sleep.

Another problem is the size of the image continually grows. After some time, I needed to upgrade both my memory and my hard disk drive space. The function itself tests for adequate memory and storage space each time it is called and will not proceed if there are any limitations. This has happened a few times in the past, resulting in my needing to rush out to the all-night computer store to buy more memory or a larger hard drive.

The Federal government has contacted me about this function. They would like a copy and the driving program ported onto each computer used in all government offices. The person I talked with said something about cutting down on the sick time and medical leave costs.

For some time I have been looking into a program that will convert the stored image file into a GIF format file. With this utility and the OS-9 gifshow program, it should be possible to view the image on the screen. If all goes well, I'll have such a utility to share with you next month.

Editors Note - Due to unforeseen circumstances, Mr. Gray will not be writing any more columns. It seems his experiments at printing an image of his stored essence resulted in his untimely demise. We will miss him.

Hardware, From the OutSide In

Intel's PentiumPlus

by Mark Griffith

Mr. Griffith has been an electronic tinkerer for some time. He has no qualifications and rarely knows what he is doing. However, he writes good and is willing to send in something each month. That's why we print his ramblings.

With all the hoopla going on recently about the PowerPC and Intel's 486DX2 and Pentium processors, I thought it would be interesting to our readers to learn more about something Intel has had up their sleeve for some time now.

Scheduled for release in the first quarter of '95 is the new **PentiumPlus** processor. This is much more than a just suped-up Pentium! With an external clock speed of up to 200 Mhz and clock tripling internal hardware, this chip will make every piece of software ever written run faster than ever before. Yes, every piece of software! Intel, through reverse engineering techniques, has successfully included an automatic emulation mode for not only the entire Intel ix86 line, but also for all versions of the 6502, Z80, and the complete Motorola line.

For the first time ever, one computer system will be able to run software designed for the Macintosh, Apple II series, Commodore VIC20, C64, and C128, All Radio Shack TRSDOS machines, as well as our trusty CoCo I, II and III, all IBM clone machines, Ataris, and more. Timex Sinclair and TI99 owners will have to wait for software emulation being developed right now. With this new design, Intel has finally succeeded in locking up the entire microprocessor market. Immediately after the announcement, Intel stock rocketed up 200% while all other microprocessor makes stocks fell through the floor. Motorola announced the immediate layoff of all their employees (except for upper management, of course).

Details, Details

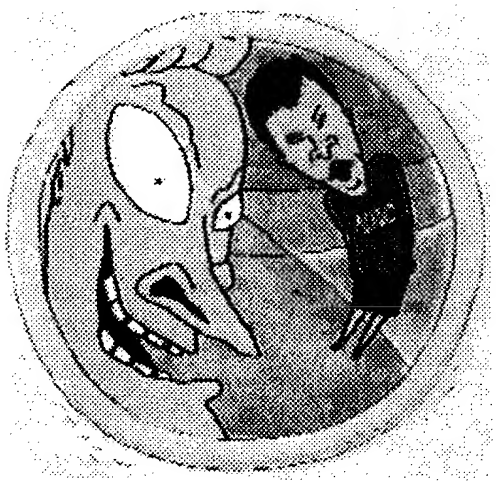
The PentiumPlus features a number of innovative ideas that have never been thought possible. A few are listed below.

- 256 Megabyte internal cache. The entire OS and all applications can run without needing to access external memory. Of course, boot time is now measured in the number of cups of coffee that can be consumed during the wait (Norton CoC index).
- Super Instruction Prefetch (SIP) technology. The chip figures out what the next instructions *should be* and executes them without needing to actually read them. This reduces execution time enormously and allows applications to be developed faster since error checking will be done at run time and bad coding techniques will be covered up by the microprocessor itself.
- Channelled-Reduction-in-Associative-Processing (CRAP) will allow the PentiumPlus processor to take advantage of new compilers now being developed that will split a program into billions and billions of little pieces, each to be processed simultaneously. The number of pieces that can be completed in one internal clock cycle is called a Sagan unit. In the near future we will be measuring CPU performance in Billions Of Sagans per Second. The most recent PentiumPlus chip is rated as BOSS 302.

Caveats

One problem with the PentiumPlus is the power usage. To run at a clock speed of 200 Mhz and perform the built-in emulations generates tons of heat. The first units required over 200 watts of juice just for the CPU! Needless to say, Intel has acquired a micro-cooler that will be attached to each chip. They also recommend fans that can move 300 CFM be installed in the computer box. These requirements, along with that needed for the chip itself, will require a 220V 100 AMP outlet that should be on a separate line than your normal household circuits. Industrial users won't have any problem with this. One good side—you won't need any heat in that room during the winter, but air-conditioning requirements will soar. In addition, some of the first PentiumPlus chips released to beta testers had some rather nasty bugs. Those returned to Intel and examined under a microscope

revealed the problem. This is what they saw:



Engineers aren't sure how this happened. Intel announced that this might be the result of a computer virus that hit them late last year. However, they are convinced that the "Beavis and Butthead" bug has been removed.

New machines using the PentiumPlus technology are scheduled to ship in the latter part of 1995. At press time, prices are expected to be about 150% higher than current machines using the 486DX2 or Pentium processors. When asked about this, an Intel spokesperson said, "If you want the latest technology, you have to pay the piper, errr....., I mean price."

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From The Jargon File

Cosmic Rays *n.* - Notionally, the cause of bit rot. However, this is a semi-independent usage that may be invoked as a humorous way to *handwave* away any minor *randomness* that doesn't seem worth the bother of investigating. "Hey, Eric — I just got a burst of garbage on my tube, where did that come from?" "Cosmic rays, I guess." Compare *sunspots, phase of the moon.* The British seem to prefer the usage 'cosmic showers'; 'alpha particles' is also heard, because stray alpha particles passing through a memory chip can cause single-bit errors (this becomes increasingly more likely as memory sizes and densities increase).

Factual note: Alpha particles cause bit rot, cosmic rays do not (except occasionally in spaceborne computers). Intel could not explain random bit drops in their early chips, and one hypothesis was cosmic rays. So they created the World's Largest Lead Safe, using 25 tons of the stuff, and used two identical boards for testing. One was placed in the safe, one outside. The hypothesis was that if cosmic rays were causing the bit drops, they should see a statistically significant difference between the error rates on the two boards. They did not observe such a difference. Further investigation demonstrated conclusively that the bit drops were due to alpha particle emissions from thorium (and to a much lesser degree uranium) in the encapsulation material. Since it is impossible to eliminate these radioactives (they are uniformly distributed through the earth's crust, with the statistically insignificant exception of uranium lodes) it became obvious that you have to design memories to withstand these hits.

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